I/S DESIGN TEAM PERFORMANCE: A CONTROL THEORY PERSPECTIVE

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CISR WP No. 198
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Abstract

The control relationship between project managers and team members is a central aspect of the working of any I/S design team. This paper uses control theory to develop measures of managerial control and team member control from both output and process perspectives. The control relationship is studied for 41 actual design teams. Results indicate that high performing teams exhibit both strong process control by managers and strong outcome control by peers.

1.0 I/S DESIGN TEAM PERFORMANCE: A CONTROL THEORY PERSPECTIVE

The increased use of information technology as a key element of strategy has been well documented (Bakos and Treacy 1986, Cash and Konsynski 1985, Ives and Learmonth 1984, Parsons 1983, Rockart and Scott Morton 1984). And yet, the ability to effectively manage the development of information systems (I/S) still represents a significant challenge. Kemerer (1989), for example, noted that backlogs in I/S have been increased substantially over the last decade and a high percentage of systems finish over budget and late. In this paper we examine the performance of I/S design teams from the perspective of control theory.

While clearly not the only theory that is applicable to this issue, the control relationship between the project manager and the team members is central to effective performance in this project-oriented task environment. Because most I/S design teams are composed of a number of different roles, including manager, designers, and users, understanding the underlying relationships among these roles is a critical step in developing a model of effective I/S design. One aspect of these relationships is the pattern of influence among members on a team (Boland 1978, Robey and Farrow 1982). Salaway (1987) argued that interactions among these roles occur at the intersection where user knowledge (business knowledge) and designer knowledge (I/S knowledge) meet. Each kind of knowledge must influence the other effectively in order to design information systems that can better meet user needs. In addition, designers and users bring different goals, skills, expectations, and motivations to the design process. Thus, a traditional task of the

manager is to influence both designers and users to work toward the team's goals instead of their own goals.

The above discussion fits quite well with a control perspective of performance. Flamholtz *et al.* (1985) defined control as *the organization's attempts to increase the probability that employees will behave in ways that lead to the attainment of organizational goals*. Weber (1947) defined control as a process of creating and monitoring rules through hierarchical authority. In his view, control systems regulate patterns of interaction to restrict employees' behavior. Ouchi (1979) saw control as an evaluation process which is based on the monitoring and evaluation of behaviors or outputs.

In the leadership literature, control has been defined as a leader's taking actions that induce a subordinate to adopt organizational goals (House and Dessler 1974, Jermier and Berkes 1979, Schriesheim *et al.* 1976). Thompson (1967) and Reeves and Woodward (1970) defined control as a cybernetic process of testing, measuring, and providing feedback with respect to a defined goal structure.

We will argue for a perspective of control that includes both managerial control and collegial control. That is, for the purpose of studying I/S design teams we will consider both control as exercised by a project manager and control exerted by members of the team on each other.

This perspective is reflected in many studies in the MIS design literature. For example, Boland (1978), De Brabander and Thiers (1984), Henderson (1988), and others investigated different patterns of influence between designers and users in the design of

information systems. They found that strong mutual influence of designers and users produces an environment that better matches the way design actually takes place. Keider (1984) and Schmitt and Kozar (1978) found that most projects that lacked the basic management principles of such planning and control had failed. Similarly, Mills (1971) and others have focused on leadership as a predictor of design team performance.

In the following we synthesize a number of control theories to provide a model of the team process in I/S planning and design. A central proposition of the model is that managerial control and team-member control can explain a significant portion of the variation in team performance. We test the proposition using empirical data gathered from 41 I/S design teams and discuss the implications for the I/S function.

2.0 ALTERNATIVE CONTROL MODELS

Mantei (1981) claimed that the two predominant control structures in I/S planning and design are the chief programmer team proposed by Mills (1971) and the egoless programming team proposed by Weinberg (1971). In the former, the decision-making authority belongs to the chief programmer, while in the latter, control is diffused throughout the team membership. Communications are centralized in the chief programmer design team, but are decentralized in Weinberg's team. That is, a chief programmer team can be characterized as having strong managerial control while Weinberg's team is characterized by strong team-member control.

March and Simon (1958) proposed that task predictability largely determines what type of control structure is appropriate. When tasks are routinized and predictable, hierarchical control is effective because coordination and control by plan and schedule is possible; when tasks become variable and work sequencing is difficult to predict, coordination by feedback is necessary and decentralized control is more effective. Bavelas (1950) and Leavitt (1951), in their experiments on centralized and decentralized problem-solving behavior, found that decentralized groups take more time and generate twice as many communications as centralized groups. Such research suggests that a chief programmer team structure would be suited to many types of I/S design tasks, while a decentralized team structure might be more effective for other types.

The position we take in this paper is that neither the purely hierarchical approach nor the purely decentralized approach is appropriate in most real software development situations. First, as Yourdon (1976) pointed out, the effective chief programmer is a rare individual; most so-called chief programmer teams are headed by someone who is unlikely to adequately handle the communication and decision-making complexity. Second, although the decentralized group is lauded for its open communication channels, such design teams often fail to finish their tasks on time (Mantei 1981).

In this paper we propose a third alternative for modeling effective I/S planning and design. This team structure is characterized by both strong managerial control and strong team-member control. Strong team-member control is necessary in modern software development practice because tasks in I/S planning and design are difficult in

nature; strong managerial control is necessary because diverse, often competing, goal sets must be managed in order to produce products as rapidly as possible to meet an organizational set of goals.

We believe that both managerial control and team-member control can be increased at the same time. In general, past studies of small group behavior assume a zero-sum view of control in design teams (Cartwright and Zander 1968, McGrath 1984). Given the zero-sum assumption, an increase in the control exercised by team members must be accompanied by a reduction in the control exercised by the manager. With this assumption, these past studies have indicated which design team structure is more effective in terms of task contingency. This perspective suggests that a Weinberg group would function well in difficult I/S development projects that are not time-constrained and/or have an existing set of shared goals. In a software project with a tight deadline that involves users from many functional areas, these assumptions are often incorrect. Further, the literature shows a major pattern of weakness in relation to these assumptions. Although a great deal has been learned about the potential influence of the leader's behavior, leader behavior alone accounts for only a small portion of performance variance in most empirical studies (Kerr 1977).

In a view that is contrary to a zero-sum perspective we maintain that strong managerial control can be achieved without sacrificing team-member control. Tannenbaum (1968) claimed that both the manager and the employee can increase their influence together without a negative impact upon one another. He also reported that in his

comparative analysis of several different organizations, performance was correlated with the sum of the managers' control and the subordinates' control. Similarly, Bartolke et al. (1982), Clegg (1981), and Hofstede (1967) provided arguments consistent with the hypothesis that strong managerial control and strong team-member control can exist at the same time. Conceptually many scholars recognize this fact, but research has tended to focus on either a bivariate relationship between managerial control and performance or between team-member control and performance (Ouchi 1979, 1977; Eisenhardt 1985, Mills 1983, Peterson 1984). Empirical studies have also tended to emphasize that only one form of control is desirable at a time depending on the contingency of tasks (Ouchi 1979, 1977; Kerr and Jermier 1978, Jermier and Berkes 1979).

Tannenbaum (1968) claimed that a high degree of control by the manager is necessary for the efficient administration of an organization and, at the same time, a high degree of team-member control is also necessary to foster identification, motivation, and loyalty. Lickert (1961) has also suggested the importance of a high level of mutual influence within teams as the basis for effective coordination of organizational activity as well as for the integration of the goals of individual members and of the organization. These conditions, leading to effective performance, entail significant control exercised by persons at all levels, the manager as well as all of the team members. Thus, we propose:

P1: ***Increased levels of both managerial control and team-member control have a significant positive effect on the performance of design teams.***

In the following sections we develop the theoretical basis for the inclusion of specific variables into our model.

2.1. Managerial Control

Managerial control refers to the manager's attempts to influence employees to behave in accordance with organizational goals. Control-oriented behavior for an I/S project manager includes defining and documenting the work to be done; assigning functional analysis and coding tasks to team members; establishing performance guidelines through task feedback; comparing actual performance to performance standards; and initiating corrective action as necessary (Katz and Lerman 1985).

These types of managerial behavior are consistent with a range of research on managerial control (Flamholtz *et al.* 1985, Jermier and Berkes 1979, Schriesheim 1978). Flamholtz *et al.* (1985) claimed that the core control system is composed of planning, a measurement system, feedback, and a reward system. Both the Jermier and Berkes (1979) and the Schriesheim (1978) studies claimed that a leader's behavior can be viewed as a control mechanism which encourages employees to behave consistently with the goals of the organization and discourages them from doing otherwise.

Recent control theories (Eisenhardt 1985, Ouchi 1979 and 1977, Ouchi and Maguire 1975, Peterson 1984) claimed that managerial control can be established by either behavior-based control or outcome-based control. According to this view, behavior-based control refers to the extent that the manager monitors and evaluates team members'

behavior in order to assist them. In contrast, outcome-based control is the degree to which the manager monitors and evaluates only the outcome produced by the team members.

Leadership behavior studies (House and Dessler 1974, Howell and Dorfman 1981, House and Mitchell 1974, Jermier and Berkes 1979, Schriesheim 1978) provide a robust characterization of managerial behavior control. These studies have identified three dimensions of managerial behavior control: (1) ***role clarification***: clarifying management expectations of subordinates in their work, (2) ***work assignment***: assigning subordinates to specific tasks, and (3) ***procedure specification***: enforcing rules, procedures, and work methods. In this paper we have adopted these three dimensions to characterize the manager's *behavior control* in I/S planning and design projects.

To characterize the manager's *outcome control*, we have adopted perspectives from communication and cybernetics theories (Campion and Lord 1982, Flamholtz *et al.* 1985, Sorensen and Franks 1972). According to these theories, ***outcome feedback*** is the most relevant dimension of outcome-based control. Outcome feedback for I/S design teams can be operationalized in terms of team goal achievement and the achievement of interim design activities. The latter reflects a common practice in I/S design of decomposing team goals into a series of milestones. These milestones then provide a basis for outcome control (Katz and Lerman 1985, Keider 1984).

2.2 Team-Member Control

Recently several researchers have pointed out that managerial control accounts for only a small portion of the criterion variance, such as performance and job satisfaction, in most empirical studies of leadership. Two explanations have been provided for these findings (Howell and Dorfman 1981, Kerr 1977, Kerr and Jermier 1978). First, as we have noted, managerial control is exercised through the manager's intervention process. Therefore, the actions or style of control of a given manager might be perceived differently by different employees. Second and more important, most empirical studies ignore team member's self-control, which may be acting in such a way as to prevent or neutralize the manager's influence.

In this self-control process a person faced with response alternatives chooses what otherwise would be regarded as a low-probability response (Thoresen and Mahoney 1974, pp. 12). Self-control is differentiated from freedom or *laissez faire* in that it is related to organizational effectiveness.

Unlike managerial control which is exercised through the manager's intervention process, team-member control refers to self-control or self-management by team members. One common perspective found in the literature, i.e., Slocum and Sims (1980) and Van de Ven *et al.* (1976), is that self-control is likely to be implemented when the organization cannot adequately measure behavioral performance or standardize transformation procedures. In other words, self-control is resorted to when management does not have any other choice. In contrast, a second view such as Manz and Sims (1980) and Mills

(1983), is that self-control can be implemented by the team members' own will and that managerial control and team-member control can be operative at the same time. As discussed above, we will investigate the extent to which this second view is applicable in the context of I/S design. We define team member control in terms of the same types of behavior used to define managerial control. The key notion is that the control behavior that guides the team towards achievement of organizational goals is exercised by a team member rather than a manager.

3.0 RESEARCH DESIGN

This section describes the design and data collection of the field study conducted to explore our hypotheses concerning control in I/S planning and design teams.

Our plane of observation is that of the teams. As such, we chose key informant analysis as an appropriate research method (Seidler 1974). As Phillips and Bagozzi (1981) have noted, the measurement of team-level properties has often entailed the use of a key informant method. The key informant method is a technique for collecting information on a social setting by interviewing (or surveying) a selected number of participants. Although the use of key informants has traditionally been associated with qualitative methodology (Lofland 1971), several researchers (Seidler 1974, Silk and Kalwani 1982, Phillips and Bagozzi 1981) have used key informant methodology in conjunction with procedures for collecting survey data to obtain quantifiable measures on organizational characteristics.

In these situations, survey respondents assume the role of key informants and provide information at the aggregate or collective unit of analysis (e.g., team or organizational properties), rather than reporting personal feelings, opinions, and behaviors (Campbell 1955). In our research, we utilized key informants selected from the team to report on the control behaviors of three key roles: project manager, I/S designer, and domain representatives (see Table 1). At least one informant from each role was surveyed, enabling us to have two informants per role plus a self report (e.g., a manager informing on the managerial role.)

We administered questionnaires to 432 individuals in 48 design teams in 10 organizations. We used two basic types of instruments: a team process questionnaire for designers, domain representatives, and project managers, and a performance questionnaire for stakeholders, (i.e., non team members). The first type of questionnaire covered the design process. That is, it surveyed control structures with questions on the I/S planning and design process. We anchored the questions to the role being assessed. The team process questionnaire for project manager and the team process questionnaire for designers and domain representatives had slight changes in wording to reflect their position on the team. We used stakeholders to assess team performance in order to avoid an obvious common method bias.

Selection of Design Teams: In choosing design teams we limited group inclusion to a project team which had worked together for a significant period of time (approximately 6 months). The project size was controlled by number of individuals (5-10) and duration

Project manager:	The person who manages the focal project.
Designers:	Professionals whose expertise and duties are primarily in the area of I/S technology, system development, programming, etc. for the focal project.
Domain representatives:	Professionals whose primary expertise and duties are in the function/business of the customer/user. They should be team members of the focal project and often are customer representatives.
Stakeholders:	Professionals who are not formal members of the focal project but are affected by the output of the team or can affect the performance of the team.

Table 1 Role Definitions

	Response rate	# of people
Project manager	48/48 (100%)	1
Designer	79/96 (82%)	2
Domain representative	57/96 (59%)	2
Stakeholder	126/192 (66%)	2-4

Table 2 Response rate.

(approximately 12 months). All teams were working on designing business applications. A survey of design methodologies and CASE technology usage suggested a fairly homogeneous and standard approach to I/S design. These guidelines helped to ensure that task complexity was similar.

Selection of Respondents and Informants: For each design team one project manager, two designers, and two domain representatives, plus four stakeholders were surveyed. Since our design teams were composed of 5 to 10 people, this enabled a high percentage of individuals on the team to be surveyed.

Questionnaire Administration: The survey process involved sending the questionnaires directly to the project managers and following up with them as appropriate. Completed questionnaires were mailed directly back to us to ensure confidentiality. Confidentiality procedures were described in the questionnaire in order to increase response rate and increase the reliability of reporting. Participation of individuals was voluntary and so noted in the questionnaire.

Altogether 432 individuals in 48 I/S planning design teams for 10 companies were asked to participate in the study. Among these, 310 usable replies were received, or about 72% of the total number of questionnaires sent out. The response rate ranged from 100% for some teams to about 44% for the lowest teams. The breakdown of response rate by role is shown in Table 2.

Since each team has only one project manager, the response rate for the project manager was 100%[1]. Since response at the individual level was voluntary (i.e., an individual could return a blank form and no follow up would occur), the response rate did vary.

Of the 48 teams that received questionnaires, 41 returned at least the following: one project manager, one designer, one domain representative and two stakeholders. These 41 teams provide an informant from each role and therefore serve as the database for our analysis.

4.0 MEASUREMENT MODEL

This section discusses the measurement model used in this study. The model provides the relationships between the measured variables and the theoretical constructs we chose to study.

4.1 Measurement Model for Control

As Phillips and Bagozzi (1981), Huber and Power (1985) and others have noted, key informant analysis is subject to method bias. One critical bias relevant to this work is illustrated by Silk and Kalwani (1982). They found informants tended to exaggerate their own role's influence with respect to a buying process. Similarly, Henderson (1988)

[1] Some teams initially contacted chose not to participate due to the implied workload. These teams are not included in the response rate and may be a source of selection bias.

found evidence of systemic role bias in reporting on user influence in I/S design. Thus, for the analysis of managerial control and team members' control we differentiated self-report by both team members and the project manager in order to test for a self report bias. For details on other tactics used to address the range of informant bias discussed by Huber and Power the reader is referred to Lee (1989).

4.1.1. Managerial Control

As discussed, we measured two types of managerial control: behavior-based control and outcome-based control. Behavior control was broken down into three categories, based on leadership behavior theory (Jermier and Berkes 1979, Kerr 1977, Kerr and Jermier 1978, Schriesheim 1978, Schriesheim *et al.* 1976). These categories are role clarification (ROLE), work assignment (ASSI), and procedure specification (PROC). Each category was assessed by asking informants to respond to multiple items using seven point Lickert-type scales. These items are included in Appendix 1 and are denoted by the acronyms ROLE1, ROLE2, ASSI1, ASSI2, PROC1, PROC2. The two items for outcome-based control are denoted by OUTP1 and OUTP2. The means and standard deviations of the item scores are also shown in Appendix 1.

Internal Consistency of Operationalizations

To assess the internal consistency of these items, all 184 responses from the project managers, designers and domain representatives were tested for reliability using Cronbach

alpha. A factor analysis was performed to ensure that the outcome control and behavior control dimensions were distinct.

Reliability: The Cronbach alpha coefficients for OUTP, ROLE, ASSI, and PROC were 0.858, 0.786, 0.696, and 0.534, respectively. Our items were based on the Ohio State Leadership Questionnaire and our reliability coefficients were similar to those of Ohio State Leadership Questionnaire (Schriesheim 1978). Even though the reliability for procedure specification was low, the minimum level was achieved[2].

Factor Analysis: A factor analysis using a varimax rotation resulted in two factors accounting for 65.5% of the variance. This analysis supports the proposition that there are two dimensions of managerial control. However, the results suggest that the outcome control items and role clarification items combine to form one factor, and work assignment and procedure specification items form the second.

One reason why the role clarification items covary with outcome control can be found by examining the contents of the items. In one, the project manager "explains the level of performance that is expected of our project team members' work" and in the other, the project manager "lets our project team members know what is considered good performance". These items were taken from work on leadership behavior theory (Schriesheim 1978) in which role clarification was theorized to be one part of the manager's behavior-based control. However, in the context of I/S design, these role clarifi-

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[2] The zero-order correlations for all items are available from the authors upon request.

cation items reflect what should be expected from team members. That is, they are closely related to manager's desired *outcome*. Interviews with teams supports the view that the role clarification items were interpreted as outcome control indicators most often linked to definition of milestones for the project.

Based on this analysis, we include role clarification items as part of outcome-based control. In the following analysis outcome-based control and behavior-based control are an average for the respective items and are denoted as OUTPM and BEHAM.

Convergent and Discriminant Validity

Since there were three types of informants, we can examine the convergent and discriminant validity of these measures using a multitrait-multimethod (MTMM) approach in which the informant type is viewed as a method (Silk and Kalwani 1982, Phillips and Bagozzi 1981). Table 3 is the MTMM matrix (Campbell and Fiske 1959) for managerial control, where OUTPM and BEHAM are viewed as traits, and the project manager informant ("M"), designer informant ("D"), and domain representative informant ("U") as different methods.

Convergent validity was not achieved in the OUTPM variable. The smallest correlation was 0.144 ($p>0.10$). This analysis suggests that there was an insignificant correlation between designer informants and manager informants, and between domain representative informants and manager informants. However, there was a strong correlation between the domain representative and the designer informants.

	OUTPM			BEHAM		
	DOUTPM	UOUTPM	MOUTPM	DBEHAM	UBEHAM	M3EHAM
DOUTPM	1.000					
UOUTPM	0.567	1.000				
MOUTPM	0.144	0.144	1.000			
DBEHAM	0.330	0.154	-.029	1.000		
UBEHAM	0.036	0.296	0.144	0.437	1.000	
MBEHAM	0.083	0.026	0.227	0.320	0.350	1.000

Table 3. The MTMM matrix for managerial control.

Convergent validity for behavior control (BEHAM) is strong. The smallest correlation between the responses from informants was 0.320 ($p<0.01$), which is significantly different from zero. The strongest correlation can be found again between the responses by the designer informants and the domain representative informants.

There are two possible reasons why we did not achieve convergent validity for outcome-based control. First, since the weakest correlations were due to the manager informants, there might be self-report method bias. However, this does not explain why convergent validity was achieved for behavior control. Second and more probably, this may be explained by differences between managerial control given and managerial control received (Ouchi 1977). Many researchers have assumed control is realized only in dyadic relationships between social actors. Wrong (1968), however, asserted that managerial control need not be exercised to exist. Even though control is usually defined as the capacity to influence others, he emphasized that there is a distinct difference between the capacity to control and the actual practice of control. This distinction was noted by Cobb (1984) and Provan *et al.* (1980), as well. Since designers and domain representatives are members of the I/S planning and design team and subordinates of the project manager, their perceptions of managerial control can be viewed as managerial control received. The project manager's perception of his managerial control can be viewed as managerial control given. Outcome-based control might not be perceived by the team members if they are performing well from the perspective of the project manager. In this case the project manager might closely monitor the outcomes of his team members and may claim

that he is exercising strong outcome-based control, but his team members may not perceive strong managerial control.

This reasoning can explain why we have achieved convergent validity for BEHAM. Since behavior control involves manager's behavioral interaction with team members, the distinction between control given and received is not strong.

From the above discussion we separate managerial outcome control given (*managerial outcome control perceived by the manager*) from managerial outcome control received (*managerial outcome control perceived by the team members*). Since managerial outcome control received is assessed by two categories of key informants, the designer and the domain representative informants, we can test discriminant validity using an MTMM approach. No violations occurred in this case indicating convergent and discriminant validity. However, managerial outcome control given can not be tested (we have only one informant); hence we must recognize the potential weakness of this measure.

In the case of behavior based control, convergent and discriminant validity was achieved. Applying the same logic of the above argument to behavior control, the strongest correlation was also found between responses by designer and domain representative informants. In an analogous manner to the outcome control dimension, we separate behavioral control into behavioral control received (measured by the average of designer and domain representative responses) and behavioral control given (measured by the managers response). This separation has the benefit of enabling subsequent analysis to

directly examine the relationship between a project manager's perceptions of control and team performance.

In summary, we have convergent and discriminant validity for managerial outcome control received and managerial behavior control received. Managerial outcome and behavior control given is measured based on only a single informant. While the items show internal reliability, we can not assess the convergent or discriminant validity. In the following section, we examine the measured validity for team member control.

4.1.2. Team-Member Control

The existing literature (Manz and Sims 1980, Mills 1983, Slocum and Sims 1980, Van de Ven *et al.* 1976, Tannenbaum 1968) does not differentiate team members' control by the roles of team members. However, in this study team-member control was divided into two types: designer control and domain representative control. The rationale for differentiating these two types of roles is that their tasks have been viewed by researchers quite differently. Designers are expected to build an information system. Domain representatives, on the other hand, are expected to supply relevant business knowledge. Therefore, in our study we used separate items to measure designer control and domain representative control. For each role, team member control was measured by two dimensions, giving four variables: designer outcome control (OUTPD), designer behavior control (BEHAD), domain representative outcome control (OUTPU), and domain

representative behavior control (BEHAU). The items used to measure them are shown in Appendix 2 with their means and standard deviations.

Internal Consistency of the Operationalizations

Since most of the empirical literature does not differentiate the type of team members, we need to test whether our differentiation is justified. This can be tested by examining the correlations between designer control and domain representative control at the item level; that is, whether items intended to measure domain representative control are significantly different from items intended to measure designer control. Table 4 shows the zero order correlations between items used in the questionnaire.

Scanning this matrix shows that all the correlations between the items for measuring designer outcome control and domain representative outcome control are significant ($p<0.001$). In addition, all the correlations between the items for measuring designer behavior control and domain representative behavior control are significant ($p<0.001$). On the other hand, the items measuring behavior-based control of any role were not correlated with items measuring outcome-based control at the $p=0.01$ level.

Therefore, we can conclude that items used in the questionnaire can differentiate the theoretical constructs, outcome-based control and behavior-based control -- but that there is no difference between designer control and domain representative control. To further clarify our argument we performed a factor analysis.

Factor analysis: In order to verify that the data reflects the two primary dimensions of outcome and behavior control, a factor analysis was performed using varimax rotation.

	OUTPD		OUTPU		BEHAD		BEHAU	
	OUTPD1	OUTPD2	OUTPU1	OUTPU2	BEHAD1	BEHAD2	BEHAU1	BEHAU2
OUTPD1	1.000							
OUTPD2	**0.659****	1.000						
OUTPU1	**0.456****	**0.277****	1.000					
OUTPU2	**0.361****	**0.514****	**0.665****	1.000				
BEHAD1	0.107	0.076	0.065	0.103	1.000			
BEHAD2	0.157*	0.178*	0.057	0.106	**0.445****	1.000		
BEHAU1	0.014	-.042	0.139	0.084	**0.445****	**0.289****	1.000	
BEHAU2	0.046	-.011	0.183*	0.108	**0.260****	**0.475****	**0.5482****	1.000

Table 4. The zero-order correlation between item measures for team control.

(**: $p<0.01$ and *: $p<0.05$)

	OUTPT			BEHAT		
	DOUTPT	UOUTPT	MOUTPT	DBEHAT	UBEHAT	MBEHAT
DOUTPT	1.000					
UOUTPT	**0.713**	1.000				
MOUTPT	0.149	0.046	1.000			
DBEHAT	0.044	0.044	0.056	1.000		
UBEHAT	0.116	0.359	-.087	**0.570**	1.000	
MBEHAT	-.170	-.084	-.026	0.104	-.085	1.000

Table 5. The MTMM matrix for team member control.

Two factors resulted accounting for 59% of the variance and are consistent with the interpretation of outcome and behavior control. Factor loadings for behavior control items ranged from .696 to .786 while those for outcome ranged from .738 to .801. These results support the premise that we measured two distinct dimensions.

Reliability: Since we find only two dimensions of team-member control, we average designer outcome-based control and domain representative *outcome control* (denoted by OUTPT), and designer behavior and domain representative *behavior control* (denoted by BEHAT). The Cronbach alphas for BEHAT and OUTPT were 0.7440 and 0.7934, respectively. We can also test to determine if any given item does not merit inclusion by examining corrected item-total correlations (Carmines and Zeller 1983). Results show reliability could not be increased by removing any single item. This reinforces our decision to aggregate the items. In sum, if we aggregate designer and domain representative control items, the items for team-member outcome control and the items for team-member behavior control show good internal consistency of the operationalizations.

Convergent and Discriminant Validity

We can again use the fact that we have multiple informant types to perform a MTMM analysis and assess convergent validity. Table 5 is the MTMM matrix for team-member control, where OUTPT and BEHAT are viewed as traits, and the type of informant, i.e., designer, domain representative and project manager, as different methods.

Note that neither convergent validity nor discriminant validity is achieved because of the manager informants' responses. If we eliminate the manager informants' responses, both convergent validity and discriminant validity would be achieved. One explanation of this could be related to the working relationship between designers and domain representatives. Since designers and domain representatives work as a team, there should be strong interactions between these members. Each of these roles has prime responsibility for input and design of the system. However, project managers are often concerned with a wider range of management issues (Allen et al. 1979). To the extent that designers and domain representatives have more opportunity to work together than with the project manager, they would be more accurate sources of information concerning team member control behavior.

However, since we cannot test the above argument with survey data (although this idea was confirmed through interviews), we separate scales to assess team-member control: (1) team-member outcome control as *perceived by the team members*, (2) team-member behavior control as *perceived by the team members*, (3) team-member outcome control as *perceived by the manager*, and (4) team-member behavior control as *perceived by the manager*. In effect, we separate the perception of the project manager in a manner similar to that for the managerial control variables. As a result, the underlying measurements for each variable have good reliability, and for the team members we show convergence across multiple informant types.

4.2 Measures of Performance

We used subjective measures to assess performance because of the substantial problems involved in using objective measures for this task (Kemerer 1989, Henderson 1988). Since our study involved teams from multiple organizations, use of internal accounting systems data to measure performance was inconsistent. Each organization and teams within organizations not only varied in terms of data collected but varied widely in terms of the integrity of this data collection process. Thus, expert judgement became our best source of performance data.

The performance of the design teams, in terms of their efficiency (EFFI), effectiveness (EFFE), and elapsed time (TIME) was assessed by non-team stakeholders. Stakeholders are individuals who were not formal members of the project but were directly affected by the output of the team or could directly affect the team's performance. Examples include senior executives (I/S and line) who sponsored the project or had management responsibility for its successful completion, implementation, or ongoing usage. The number of stakeholders who filled out the performance questionnaire per team ranged from two to five with an average of 2.6.

Appendix 3 shows the questionnaire measures used for each dimension of performance. Except for one item, the measures for EFFI and EFFE were the same as those developed and validated by Henderson (1988). Note however that we separated two measures: "the team's adherence to budgets" and "the team's adherence to schedules" for the efficiency dimension. However, there were several instances in which the question

concerning the team's adherence to budgets was not answered. Follow-up interviews suggested that stakeholders might not have known specific details of the budgets. Therefore, we dropped the budget item to improve the reliability of our measure.

Cronbach Alphas of 0.750, 0.723, and 0.736, respectively, suggest an adequate level of reliability. These values are lower than those obtained by Henderson (1988). One reason for this difference may be the increased number of organizations included in this study. While somewhat low, these reliabilities are still within an acceptable range (Nunnally 1967).

To be sure that our 41 teams represent independent sample points, i.e., that the variance in the dimensions of performance arises from genuine differences among the design teams rather than the organizations, we ran three ANOVAs to test the hypothesis that the performance variables could be explained by an organization variable. The multivariate *F*s were 1.075, 1.881, 1.581 for efficiency, effectiveness, and time, indicating that there were no significant differences across the organizations ($P>0.10$). Since the variations in performance variables among the organizations were not greater than the within-organization variations, we have support for the general notion that performance variables varied due to differences across teams. In the following analysis, therefore, all design teams are treated as individual sample points.

5.0 AN EMPIRICAL TEST OF THE TEAM PROCESS MODEL

The underlying theme for our proposition is that control behavior, both outcome and behavioral, is positively related to the performance of I/S design teams. As discussed, this view is widely advocated in organizational control literature and has strong empirical evidence to support it [see Tannenbaum (1968) for a review]. This research attempts to extend this theory to the context of I/S planning and design.

The control variables we measured are managerial behavior control (BEHAM), managerial outcome control (OUTPM), team-member behavior control (BEHAT) and team-member outcome control (OUTPT).[3] Each control variable has been assessed by team members (designers and domain representatives) and the project manager. Performance is measured in terms of efficiency (EFFI), effectiveness (EFFE) and elapsed time (TIME).

We test twelve hypotheses that reflect the relationships between each of these variables and our three performance variables. In each case, the null hypothesis is that no relationship exists. The results of these tests are summarized in Tables 6 and 7. Both DUBEHAM and DUOUTPT were significantly related to all performance variables. In addition, DUBEHAT was related to EFFE ($p<0.05$) and DUOUTPM was related to EFFI ($p<0.05$). The managers' assessment of the control variables was not significantly related

[3] In our notation each control variable is preceded by DU or M, where DU indicates that the designer and the domain representative assessed the variable, and M indicates that the project manager assessed the variable.

		EFFI	EFFE	TIME
Manager's assessment	Managerial behavior control (MBEHAM)	.239	.170	.046
	Managerial outcome control (MOUTPM)	-.059	-.055	.074
	Team-member behavior control (MBEHAT)	-.096	.099	-.196
	Team-member outcome control (MOUTPT)	-.012	-.161	.079
Team-members' assessment	Managerial behavior control (DUBEHAM)	.618**	.432**	.263*
	Managerial outcome control (DUOUTPM)	.243*	.199	.150
	Team-member behavior control (DUBEHAT)	.186	.330*	.125
	Team-member outcome control (DUOUTPT)	.385**	.485**	.303*

Table 6. The zero-order correlation between performance variables and control variables.

(**: $p<0.01$ and *: $p<0.05$)

	Explanation	EFFI	EFFE	TIME
DUBEHAM + DUBEHAT	Total amount of behavioral control	.565**	.524**	.270*
DUOUTPM + DUOUTPT	Total amount of outcome control	.394**	.404**	.268*
DUBEHAM + DUBEHAT + DUOUTPM + DUOUTPT	Total amount of behavioral and outcome control	.569**	.555**	.329*
DUBEHAM + DUOUTPT	Total amount of control in dydadic relationship	.613**	.569**	.351**

Table 7. The zero-order correlations among total amount of control and performance variables.

(**: $p<0.01$ and *: $p<0.05$)

to any performance variables. As discussed earlier, the results using a manager's assessment of his own control (MBEHAM and MOUTPM) can be interpreted in two ways. First, these measures are self-reports, so position bias may be operating: the natural conclusion is that a manager's own self-report overestimates how much influence he is exercising. Second, the two measures of managerial control may actually measure different things: managerial control as assessed by the project manager may refer to control given by the project manager and managerial control as assessed by team members can be viewed as control received, as Ouchi (1977) has claimed.

To assess the first argument, we ran two paired t-tests. The results show a significant difference between self-reports by the project managers and non-self-reports by team members ($t(OUT) = 4.12$, $p < .01$, $t(BEH) = 4.01$, $p < .01$). Thus, we cannot reject the hypothesis that there is a significant self-report bias.

Earlier we argued that, based on the measurement model, the second interpretation was at least plausible. If we adopt this view, managerial control received is more significantly correlated with performance variables. In the case of the I/S design teams, managerial control received may be more important than managerial control given. Since I/S planning and design entails complex tasks which require much interaction among individuals with different roles (Guinan and Bostrom 1986), team members may need explicit reinforcement and coaching from the manager. Thus, managerial control should have a manifest impact on team members' perception.

We now analyze the results using assessments made by team members. When the *manager's* behavior-based control and outcome-based control were compared, the behavior-based control was more significantly related to all the performance variables. The designers and the domain representatives have different skills, role perceptions, and mental schemata which must be combined through their interactions into a final outcome (Boland 1978). These data suggest the important role of managing this interaction by providing explicit direction in the design process, which cannot be done using only outcome-based control.

The relationships among performance and the *team members'* control variables were the opposite. Among team members' control variables, outcome-based control was more strongly related to all of the performance variables than behavior-based control[4].

Team-member behavior control refers to self-control in executing a team member's own tasks, whereas team-member outcome control can be viewed as collegial control, such as providing feedback on performance. These data indicate those teams that exhibit strong collegial control, i.e., exerted peer pressure to achieve outcome commitments, were significantly higher performing.

A regression analysis using the four variables (as assessed by team members) provides support for proposition P1 and for the claim that I/S design tasks require both

[4] We assessed team-member control separately for both designers and domain representatives, and found that self-report and non-self-report measures were in agreement in this study (for the measurement model see the previous section). Thus, we can exclude the possibility of self-bias in the aggregated measures, which include both self-report and non-self-report measures of the team member control variables.

control processes to be efficient and effective. Managerial behavioral control (DUBEHAM) and team outcome control (DUOUTPT) together explain 44% and 38% of variations in the efficiency and effectiveness of the I/S design teams. However, these variables only explain 13% of the variance for the time dimension.

There are two interpretations of our findings concerning the TIME variable that seem likely. First, as discussed in Section 5.2, our subjective measures for TIME may be inadequate. We used only two items which had not been pretested by other studies. Second, TIME might be better explained by other theoretical variables not included in our study, e.g., competitive pressure among projects for scarce resources.

Our findings can be compared to those of past empirical work. Tannenbaum and his colleagues (1968) tested the hypothesis that the degree of control, exercised both by leaders (in our case the project manager) and by team-members (the designers and the domain representatives), is related to organizational effectiveness. A strict comparison between their studies and ours is difficult since they operationalize the constructs somewhat differently. They measured the leader's control by asking survey respondents "how much influence does your leader actually have in determining ... policy", and they assessed team member's control by asking "how much influence do team members have in determining ... policy?" They then added the values for leader's control and team-members' control to measure the total amount of control in the organization or subunit. Despite these differences, our results are in general agreement with theirs.

In Table 7 we generated several measures for the total amount of control. All of them showed significant correlations with the performance variables. The strongest correlations with performance variables are found in the last row of Table 7: (DUBEHAM+DUOUTPT). We can interpret this combined variable as the total amount of control in a didactic relationship. Tannenbaum *et al.* (1968) defined managerial control as the extent of a manager's influence in determining the team members' behavior. This relationship is reflected in our variable, DUBEHAM, since the managerial behavioral control can show its impact on performance through team-members' behavior. Team-member control refers to the amount of control exercised by team members and in our study is most strongly reflected in the variable DUOUTPT, i.e., a team member's outcome control.

Tannenbaum *et al.* (1968) found that the correlation between the total amount of control and effectiveness ranged from 0.29 to 0.45. In our case, the correlation between effectiveness and the total amount of control in the didactic relationship (DUBEHAM + DUOUTPT) was 0.569 ($p<0.01$)[5].

Given the support we found for the hypothesis that control variables can explain performance, a more detailed analysis of the pattern of performance between managerial control and team-member control is provided. Using the median values for DUBEHAM and DUOUTPT, we split the 41 I/S planning and design teams into four subgroups as

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[5] Tannenbaum *et al.* operationalized performance variables by effectiveness items similar to our items for the effectiveness variable.

shown in Figure 1. We then examined the average values of performance variables (EFFI, EFFE, and TIME) in the appropriate cell. As would be expected, the degree of managerial behavior control and team-member outcome control are clearly reflected in the performance variables. First, when both high managerial behavior control and high team-member outcome control were operating (Cell One), the performance variables were the best, and when both were low (Cell Four), all the performance variables were the worst. Second, when either low managerial control or low team-member control was achieved, the performance variables were not greater than those in Cell One, but were better than those in Cell Four. Although we can compare neither Cell One to Cell Two nor to Cell Three because of the small sample size ($n=5$), we can compare Cell One and Cell Four, using the t-statistic. The values of the t-statistics for EFFI, EFFE, and TIME were 3.93, 3.28, 1.72 (all significant at $p=0.01$), which supports the claim that teams with high managerial behavior control and high team-member outcome control are better performers compared to teams with low managerial behavior control and low team-member outcome control.

6.0 CONCLUSION

This result supports the proposition that a control theory perspective can be used to explain the relative performance of I/S design teams. Our research operationalizes the concepts of behavior and outcome control in the context of I/S design. Further, we apply these to notions of control behavior to both project managers and team members.

	High managerial behavior control	Low managerial behavior control
High team member outcome control	n = 15 EFFI 5.364 EFFE 5.427 TIME 4.913 Cell 1	n = 5 4.813 5.200 4.790 Cell 2
Low team member outcome control	Cell 3 4.940 4.820 4.650 n = 5	Cell 4 4.313 4.594 4.216 n = 16

Figure 1. Performance variables and the degree of control by type.

The results are consistent with previous research in control theory. That is, both outcome and behavioral control can co-exist and the greater the degree of explicit control behavior perceived by the team, the better the team's performance.

From an I/S perspective, the findings are particularly interesting. Our results suggest high performance I/S design team have managers that exhibit *behavioral* control and team members that exhibit *outcome* control. The former highlights the importance of knowledge-based leadership in an I/S design context. Our interviews reinforced this finding with an important insight. Behavioral control reflected the ability of the manager to aid the design process. The knowledge needed for this assistance, however, is *not* restricted to I/S design practice. Rather, the design process requires an *understanding* of the business (from both a technical and a social perspective). Our interviews suggested effective managers often brought domain knowledge to bear on work assignments, procedure clarification and so on. To the extent that this single study is validated, the training and selection criteria for I/S project managers must reflect their ability to provide behavioral-based control.

The significance of collegial outcome based control to performance is important in an I/S design context. For example, emerging CASE technology provides a means to easily distribute performance data on a real time basis throughout the team. These results suggest such practice could help to improve overall team performance by enabling a peer-to-peer outcome control structure, rather than the project leader hierarchy that is traditionally used.

Of course, this single study does not provide the basis to conclude definitively that managerial behavior control combined with team member outcome control is preferred. Additional research must consider factors such as task contingencies, experience of team members or technology assisted methodologies. Yet, this does provide one theoretically grounded lens with which the systematic study of high performing I/S planning and design teams can be conducted.

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Appendix 1. Managerial Control Questions

How accurate do you think the following statements are in describing your manager for the XXXXX project.

My project manager in the XXXXX project ....

	Operationalization	Mean	Standard deviation
OUTP1	gives our project team members a lot of feedback about how they are doing.	4.62	1.50
OUTP2	gives our project team members frequent feedback about performance.	4.20	1.51
ROLE1	explains the level of performance that is expected of our project team members.	4.49	1.39
ROLE2	lets our project team members know what is considered good job performance.	4.14	1.51
ASSI1	carefully defines what jobs our project team members are to do.	5.06	1.25
ASSI2	gives our project team members specific work assignments.	5.18	1.43
PROC1	develops procedures to guide our project team members' work.	4.51	1.53
PROC2	explains to our project team members how their jobs should be done.	3.56	1.48

Appendix 2. Team-Member Control Enablers Questions

Please indicate the extent to which you agree or disagree with each of the following statements.

For work relating to the XXXXX project.....

	Operationalization	Mean	Standard deviation
OUTPD1	designers/analysts give other project team members a lot of feedback about how they are doing	4.49	1.47
OUTPD2	designers/analysts gives project team members frequent feedback about performance.	4.29	1.46
OUTPU1	client/domain representatives give other project team members a lot of feedback about how they are doing.	4.37	1.34
OUTPU2	client/domain representatives gives project team members frequent feedback about performance.	4.08	1.35
BEHAD1	designers/analysts have significant freedom as to what they will do in our project.	4.25	1.54
BEHAD2	designers/analysts have significant freedom as to how they do their work in our project.	5.10	1.34
BEHAU1	client/domain representatives have significant freedom as to what they will do in our project.	4.30	1.43
BEHAU2	client/domain representatives have significant freedom as to how they do their work in our project.	4.87	1.38

Appendix 3. Performance Questions

The following questions ask you to compare the XXXXX project team to other teams. In relation to other comparable project teams you have served on or observed, how does the XXXXX project team rate on each of the following.

	Operationalization	Mean	Standard deviation
EFFI1	The efficiency of team operations.	4.49	1.25
EFFI2	The amount of work the team produces.	4.99	1.23
EFFI3	The team's adherence to schedules.	4.64	1.60
EFFI4	The teams adherence to budgets.	4.64	1.58
EFFE1	The quality of work the team produces.	5.14	1.16
EFFE2	Effectiveness of the team's interactions with people outside of the team.	4.67	1.28
EFFE3	The team's ability to meet the goals of the project.	4.91	1.45
TIME1	The team could have done its work faster with the same level of quality	4.30	1 66
TIME2	The team met the goals as quickly as possible.	4.75	1 42